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## (54) Electric cable with improved screen and process for constructing said screen.

(57) Electric cable (1), endowed with an extruded insulation (5), used for conveying energy provided with a screen of metallic wires (10, 12), wound helicoidally, according to an open helix, embedded and kept in position in a layer (7) of extruded material, eventually coincident with the protective sheath of the cable. The invention also concerns the process for the construction of the screen.

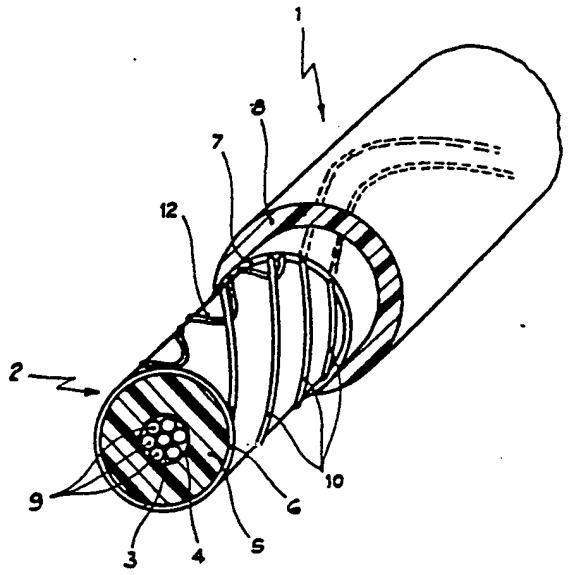


Fig. 1

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# ELECTRIC CABLE WITH IMPROVED SCREEN AND PROCESS FOR CONSTRUCTING SAID SCREEN

The present invention concerns an electric cable of the type provided with an extruded insulation, having an improved outer screen made of metallic wires, as well as the process for applying the said screen to the cable.

Electric cables with extruded insulations, generally comprise a core formed by an electric conductor, a first semiconductive layer, an extruded insulation of plastomeric or elastomeric material, and a second semiconductive layer. Moreover, upon this core, there is applied a metallic concentric screen that acts as a way of low electric resistance, apt for guaranteeing the intervention of the protections, as soon as any condition of damage in the cable is verified, that renders it necessary.

The core can also have a structure that is different from the one indicated above and can be formed, for example, by several conductors insulated from each other, and with a single semiconductive outer layer; or else one, or both the semiconductive layers can be lacking. From here onwards, by the term "core" will be intended the part of the cable underlying the electric screen that is made of wires and/or tapes of conductive material, that is generally connected to the ground. Hence, the said core comprises at least one electric conductor and one extruded insulation.

The metallic screen is generally realized with good conductor metallic wires (for example: copper) wound around the cable core.

According to a known technique, the metallic wires are wound helicoidally around the cable core, thanks to rotating bobbins which are disposed along the production line and the electrical continuity of the screen is guaranteed thanks to copper tapes. The cable core is then collected on bobbins and transferred to an extrusion line for the purpose of the application of the protective sheaths and of other eventual extruded layers.

This process requires a machinery endowed with a rotating cage that, besides being complex and costly, also requires the production line to be halted, whenever the bobbins containing wires and/or copper tapes, are about to run out.

A successive improvement for these type of cables was had with cables where the wires are wound around the core, according to a helix that is periodically inverted, known as an open helix, or S-Z helix.

Nevertheless, although the bobbins of wires result as being fixed and only th portions of wires that are close to the cable are subjected to an alternating rotation, the cable have to be immediately wound with tapes for so blocking the screen wires into position.

Hence, the tape that is metallic for realizing the electric continuity between the screen-wires, requires a rotating binding head. Hence, even when manufacturing these type of cables, there are also present rotating devices for binding with metallic tapes, and consequently, it becomes necessary to halt the production line for substituting the bobbin tape that has run out.

Moreover, with this process it results as being difficult to guarantee an even and constant spacing between the wires, as foreseen by the safety standards for this type of screen. In fact, in particular, the wires tend to become densified, in correspondence of the helix inversions, during the construction of the screen, and other local wire-shiftings can take place as a result of bends in the cable during the collecting and the laying operation.

A further limitation of the cables, having a screen thus realized, consists in the lack of longitudinal watertight sealings against the eventual infiltrations of water into the sheath, since the assembly of wires and of metallic tapes, offers a easy way for it to spread.

If a watertight sealing is required, it will be necessary to provide a further binding with fabric tapes, incorporating swelling powders, or else, the introduction of these powders prior to extruding the sheath.

The aim of the present invention is the realization of an electric cable endowed with an extruded insulation wherein the positioning of the metallic screen wires does not require any binding with tapes, in such a way as to simplify cable production and, in particular, for rendering the production to be continuous and uninterrupted.

A further aim of the invention is to realize a cable whereby the space between the screen wires is kept rigidly constant both, during cable manufacturing, as well as during cable functioning.

Another aim of the invention is to realize a cable where the screen is able to prevent the longitudinal spreading of the water that eventually penetrates into the sheath.

The invention concerns an electric cable, comprising a cylindrical core formed by at least on electric conductor and by an xtruded insulation, with a screen upon said core formed by metallic wires wound helicoidally according to an open helix, characterized by the fact that said screen com-

prises at least a further metallic connecting wire that extends longitudinally along the core and that is in electrical contact with the wires of said screen and by the fact that all the metallic wires are embedded and kept in position inside a layer of material that is xtruded around said core.

Moreover, the invention concerns a process, for applying a screen of metallic wires wound helicoidally, in an open helix configuration, around the core of a cable, characterized by the fact of comprising the steps of:

-causing the said core to advance;

-disposing on the core a plurality of parallel metallic wires according to an open helix configuration, and at least another metallic wire disposed longitudinally along the core; and

-extruding, in correspondence of the point where the wires contact the core, a layer of material, in such a way as to embed said metallic wires, and to keep them permanently in position.

The layer of extruded material can consist of an elastomeric or a plastomeric compound having a lesser thickness compared to the diameter of the screen wires for just partially embedding them; otherwise, the layer can be of a thickness greater than that of the wires' diameter. In case the wires are completely embedded, the extruded layer can coincide with the plastic material of the sheath, which is foreseen over the metallic screen.

The invention will now be described with reference to some forms of realization, illustrated in the attached drawings, whereby:

FIGURE. 1 -shows a portion of a cable, according to the invention, with some parts removed;

FIGURE 2 -illustrates an alternative embodiment of a cable according to the invention;

FIGURE 3 -shows a partial section of an extrusion-head for realizing the process according to the invention.

The cable 1, shown in FIG. 1, is a unipolar medium voltages cable, and it comprises a core 2 formed by a single central conductor 3 of stranded wires 9, for example: aluminium, around which is extruded a layer 4, of semiconductive materal, a layer 5, of insulating material, and a layer 6, of semiconductive material.

Above the core 2 there is foreseen a screen 1 that comprises a plurality of metallic wires 10, wound helicoidally in open helix configuration (that is partially shown with a broken-line), at least one metallic wire 12 which extends longitudinally along the core and a layer 7 of elastom ric material that embeds all the said metallic wires in such a way as to keep them in position and to protect them from any eventual corrosion phenomena. A protective sheath 8, made of P.V.C., polythene, or some other plastic material, covers the layer embedding the metallic screen.

The layer of elastom ric material 7 is formed by a compound, preferably an insulating compound, and it has such a thickness as to keep all the screen wires in position.

Hence preferably, the thickness of the layer is the minimum one that allows for preventing any movements of the wires, and the thickness of said layer can eventually result as being lesser than the diameter of the wires themselves i.e. with only partially embedding them.

The layer of elastomeric material can be semiconductive in case, for example, a further guaranty is desired for the electrical connection between the metallic screen and the underlying semiconductive screen 6.

The metallic wire 12, carries out the function of electrically connecting together the wire that form the just mentioned screen.

Preferably, and as shown in the figures, said wire follows an undulated course with respect to a generatrix of the core 2, in such a manner as to result longer than the core. This allows for bending the cable without causing any dangerous stresses to the connecting wire 12.

Still by way of preference, the connecting wire 12 is disposed radially more inside with respect to the wires 10, although its positioning outside the wires is not excluded.

The material forming the extruded layer 7 forms part of the so-called class of thermoplastic fillers (or non-vulcanized fillers), based on loaded elastomers. Preferably, it is formed out of a composition based on ethylene-propylene rubber, loaded with calcium carbonate, with or without the addition of plasticizers and/or lubricants, even in dependence of the particular machinery used for the processing. Other compounds can also be used, for example, compouns based upon natural rubber, styrol rubber, butyl rubber etc. loaded with other mineral loads, for example: kaolin, with or without the addition of pasticizers, and/or lubricants.

Preferably, the compound is sufficiently soft at a room-temperature, for thus allowing any slight settling movements of all the wires in their entire whole (i.e. wit: keeping their reciprocal distance) when the cable is wound and unwound.

In the cable 10 shown in FIG. 2, the core and the scr n have substantially the same structure as the cable shown in FIG. 1 and the same reference numerals have been used for indicating analogous parts; whereas the layer of extruded material 17,

that completely embeds the wires, coincides with the plastic cable sheath. This form of realization offers the advantage of eliminating an extrusion operation during cable construction.

FIG. 3 shows a partial section of an xtrusion-head by which the process according to the invention is put into practice.

The cable core 2 after having passed through the accumulator pipe (not shown), on which the metallic wires for the screen are wound and unwound, enters inside a conveyor 30 for the screen wires, formed by a cylindrical body tapered at one extremity and provided with peripherical grooves 38 inside which the metallic screen wires are lodged and guided. A likewise tapered cylindrical sleeve 31, is mounted around the conveyor in such a way as to allow the wires to enter into closed canals without any risk of their coming out.

The conveyor and the sleeve are mounted on the extrusion-head 20 through bearings (such as those shown by numeral 39 in FIG. 2) and they are caused to move with an alternating rotatory motion with respect to the extrusion-head (shown by the arrows R1, R2), thanks to a belt-pulley transmission (not shown for simplicity sake).

The inner diameter of the cylindrical body 30, is greater than the diameter of the core 2, moving inside it, so as to leave a clearance 35, along which the previously undulated connecting wire 12 passes.

Moreover, in the extrusion-head 20, there is foreseen an extruding canal 40 that receives the material which goes to form the layer 7 (or else, the cable sheath 17) embedding the screen wires.

The said canal opens on the core in a position immediately adjacent to the openings of the canals 38, through which the screen wires pass that in being subjected to the alternating rotatory motion of the conveyor 30, are layed on the core 2 (and, in particular, above the connecting wire 12) according to an open helix configuration. The thus-formed screen of metallic wires is immediately embedded by the elastomeric or plastomeric material extruded through the canal 40 in such a way that the wires are blocked in their desired position in a permanent manner, by the solidification of the compound.

Although the invention has been described and illustrated with particular reference to two preferred embodiments, it is not intended as being limited to these forms, but also extends to include and cover the obvious variations and/or modifications both, of structure and process. For example, the wires can result as being only partially embedded in the extruded layer, the connecting wire can be rectilineal, the core can comprise diverse insulated conductors tc.

## Claims

1. Electric cable (1), comprising a cylindrical core, formed by at least on electric conductor (3) and by an extruded insulation (5), with a screen upon said core formed by metallic wires (10) wound helicoidally, according to an open helix, characterized by the fact that said screen comprises at least a further metallic connecting wire (12) that extends longitudinally along the core, and is in electrical contact with the wires (10) of said screen, and by the fact that all the metallic wires (10, 12), are embedded and kept in position inside a layer (7) of material that is extruded around said core.

2. Electric cable, according to CLAIM 1, characterized by the fact that the said metallic connecting wire (12) results as being undulated with respect to a generatrix of the core.

3. Electric cable, according to CLAIMS 1 or 2, characterized by the fact that said layer (7), of extruded material, embedding the wires (10, 12), has a greater thickness than the diameter of the screen wires (10, 12).

4. Electric cable, according to CLAIM 3, characterized by the fact that the said extruded elastomeric material is an insulating compound.

5. Electric cable, according to CLAIM 4, characterized by the fact that said layer (7), of extruded material, is the cable sheath.

6. Process for applying a screen of metallic wires (10, 12), wound helicoidally, in an open helix configuration, around the core of a cable, characterized by the fact of comprising the steps of:

-causing the said core to advance;

-disposing on the core a plurality of parallel metallic wires (10) according to an open helix configuration, and at least another metallic wire (12), disposed longitudinally along the core; and

-extruding, in correspondence of the point where the wires contact the core, a layer (7) of material, in such a way as to embed said metallic wires (10, 12), and to keep them permanently in position.

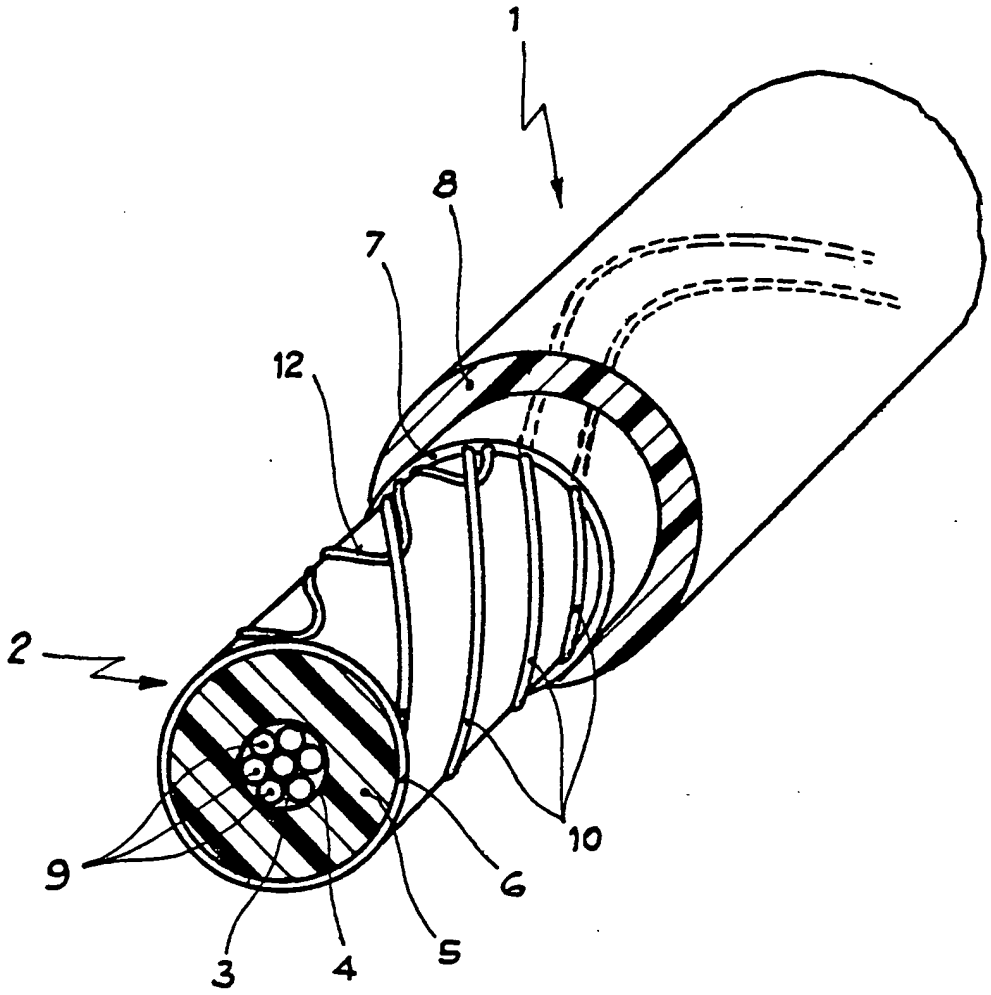


Fig. 1

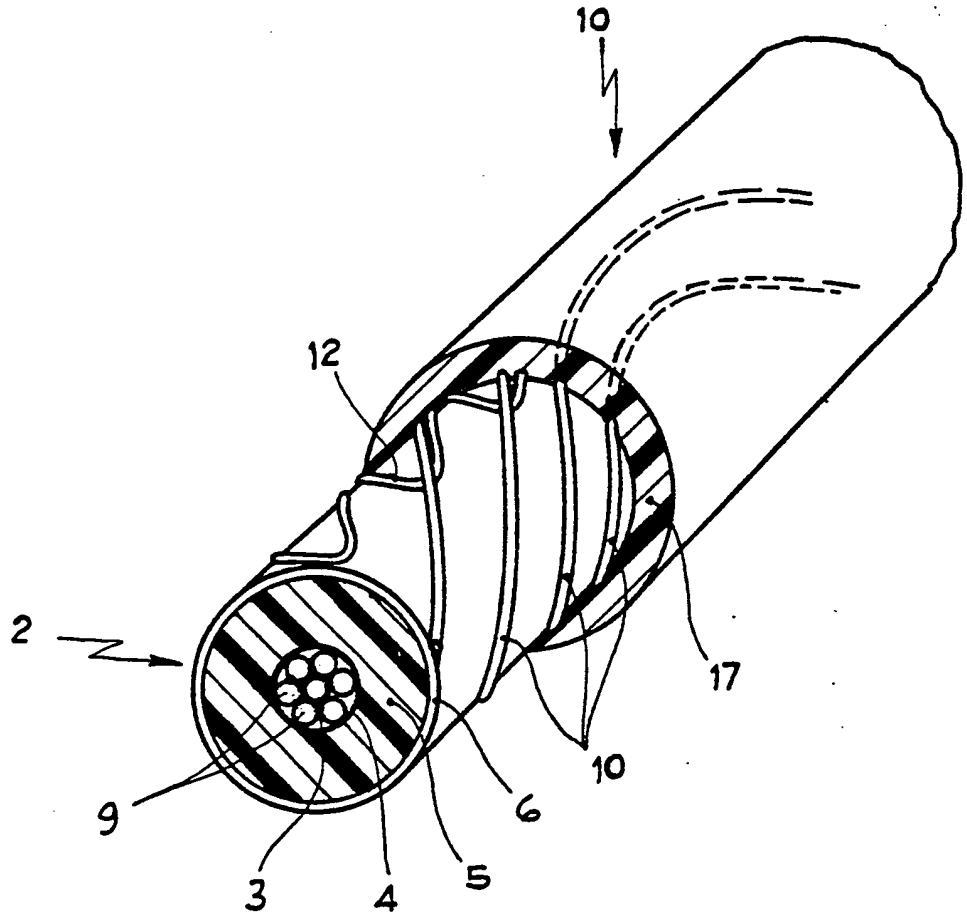


Fig. 2

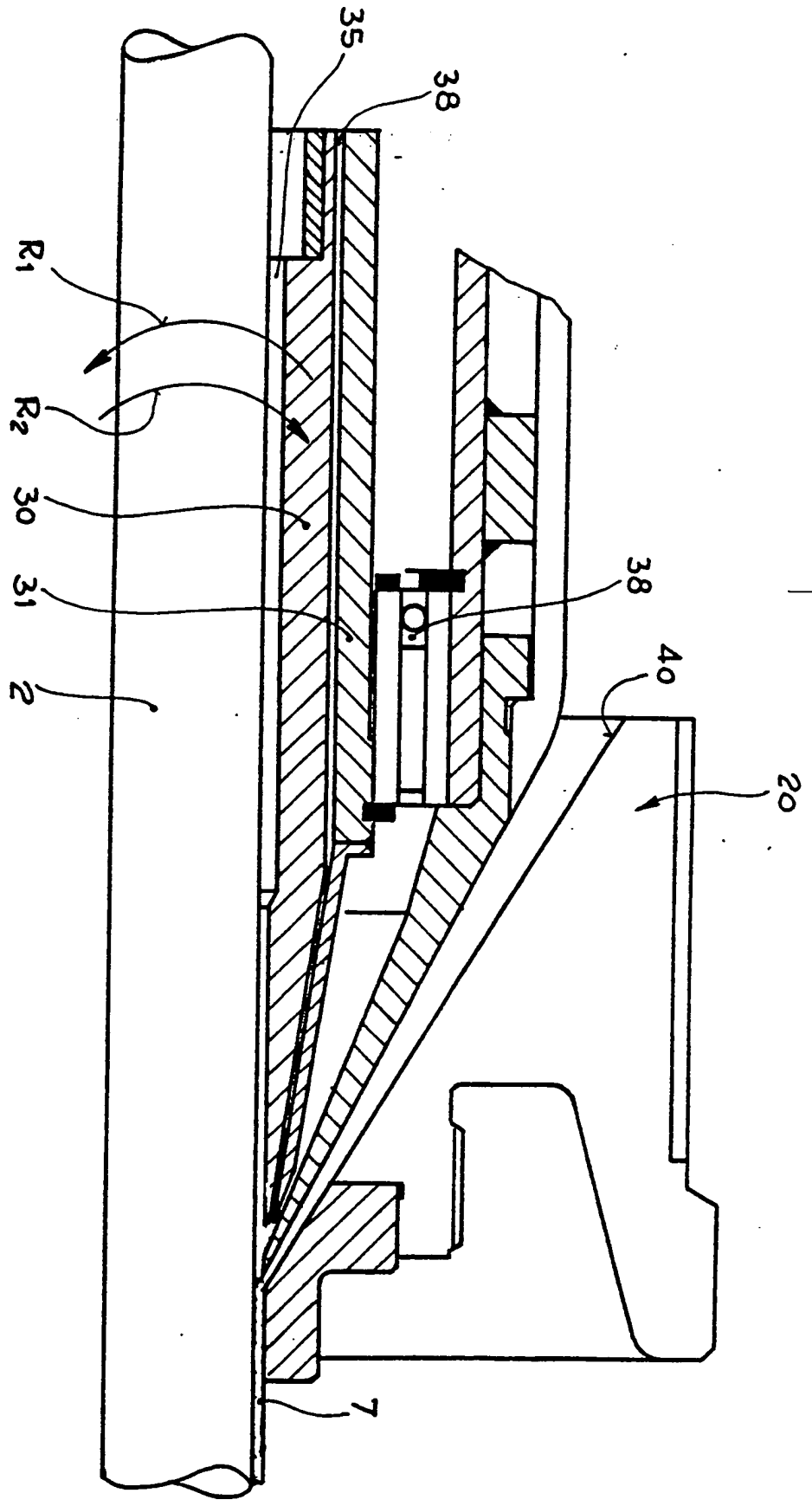


Fig. 3